

2012 ONR Naval S&T Partnership Conference & ASNE Expo

Expeditionary & Irregular Warfare
S&T - The Engine for Innovation

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O F F I C E O F N A V A L R E S E A R C H



Expeditionary & Irregular Warfare

Thrusts:

- **Command & Control, Computers and Communications (C4)**
- **Fires**
- **Force Protection and Counter IED**
- **Human Performance, Training & Education (HPT&E)**
- **Intelligence, Surveillance, and Reconnaissance (ISR)**
- **Logistics**
- **Maneuver**
- **Human, Social, Cultural, and Behavioral Sciences (HSCB)**
- **Naval Expeditionary Dog Program (NEDP)**
- **Sciences Addressing Asymmetric Explosive Threats (SAAET)**



Expeditionary & Irregular Warfare

In addition to our Thrust Areas, our enduring efforts include:

- Protecting the Force
- Lightening the Load
- “Fires as a Commodity “
- Operational Adaptation & Warrior Resilience
- “Out Think”, “Out Maneuver”, and “Out Perform”
- Energy Efficiency

Additional Programs:

- Naval Expeditionary Dog Program (NEDP)
- Human, Social, Cultural, Behavioral Sciences (HSCB)
- Sciences Addressing Asymmetric Explosive Threats (SAAET)



Expeditionary and Irregular Warfare

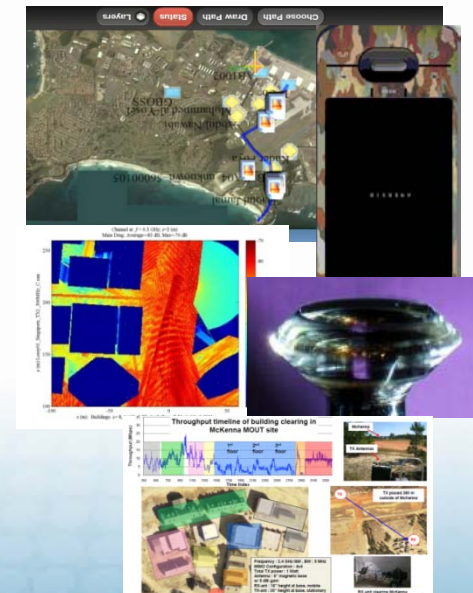
• C4 Technology Investment Areas

- Network Centric Warfare/Interoperability
 - Information Efficiency = information abstraction, information assurance; and interaction with the comms network
 - Provide only needed info, improve latency and decrease load
- Over the Horizon Communications/Gateways
 - Advanced HF – application of modern signal processing techniques, such as MIMO
- Small Unit Technologies
 - Comms efficiency – minimizing joules/bit; minimize detectability, increase spectral efficiency; directional networking
- Research Opportunities:
 - Managing user expectation for infrastructure-intensive commercial smart phone services on sparse, intermittent, low-throughput military networks
 - Managing dynamic networks – optimization with sparse, possibly dated information
 - Automated determination of “value of information” and managing and disseminating information content
 - Applicability of cyber warfare to distributed small units

C4 Thrust Manager



Mr. John Moniz





C4 (Cont'd)

• Research Opportunities:

- Managing the user's expectation for infrastructure-intensive commercial smart phone services on sparse, intermittent, low-throughput military networks
- Managing dynamic networks – optimization with sparse, possibly dated information
- Distributed, provable authentication and information security with no physical Key Mat
- Reducing size of broadband antennas (Chu and Fano limits)
- Improved channel models and estimates (non-Gaussian)
- Automated determination of “value of information” and managing and disseminating information content
- Applicability of cyber warfare to distributed small units
- Fully homomorphic encryption
- Interference alignment
- Photonics for RF processing.



Expeditionary and Irregular Warfare

• Fires Technology Investment Areas

– Targeting and Engagement

- Lightweight, low cost, day/night wide FOV target acquisition for the individual warfighter by utilizing:
 - i. Small pitch athermalized SWIR sensors using novel ROIC designs to minimize dark current ($<2.5 \text{ nA/cm}^2$) and reduce power consumption ($<400\text{mW}$)
 - ii. Advanced optical quality polymer materials of sufficient transparency (90+%) and dispersion (Abbe# 30-90) for application to large aperture (50mm+) Gradient Index of Refraction (GRIN) lens
 - iii. Doped Black Silicon as a low cost replacement sensor material for NVG devices using conventional InGaAs imagers
- Accurate target location for dismounted warfighters, at standoff distances, in all terrain and weather utilizing silicon based MEMS gyros (ARW= 0.004 deg/rt hr, Bias= 0.04 deg/hr) to achieve $<4\text{mils}$ azimuth accuracy within 4 minutes

– Advanced Weapons

- Provide low cost precision ($<5\text{m CEP}$) long range indirect fires through the use of silicon MEMS Safe & Arm devices, reduced state guidance laws, novel control actuation systems, high nitramine propellants, and advanced SAL seekers
- Next generation Remote Weapon System (RWS) technologies to provide virtual long range (2200m+) foviated vision and semi-autonomous engagement chain to enhance gunner situational awareness while reducing gunner tasking

– Advanced Ammunition

- Developing high energy density ($\sim 170 \text{ kJ/cm}^3$) energetic materials by exploiting bond energy release techniques using NanoDiamond and Polymeric CO materials.
- Improving existing warhead and propulsion capabilities at reduced size and weight through silicon based MEMS S&As and ISDs, densified propellants, and caseless ammunition propellant technology

Fires Thrust Manager



Mr. Dan Simons





Fires (Cont'd)

• Research Opportunities:

- Develop weapon flight state self-determination autonomous navigation technologies for 60mm, 81mm, and 120mm mortars with trajectory shaping for engagements in complex terrain, and less than 10 meter CEP precision.
- Develop novel aerodynamic range extension technologies for direct and indirect fires.
- Develop low cost, reduced weight Fire-From-Enclosure (FFE) propulsion technologies that meet Mil-Std-1474 requirements for use on 1000m range rocket/missile systems.
- Develop low cost 81mm mortar warhead technologies that provide comparable lethality to that of the M934 120mm mortar projectile.
- Develop low cost, light weight (<5#) warhead technology that can generate a 39 inch through hole in 8 inch double reinforced concrete structures.
- Develop fully integrated Vis-NIR-SWIR-LWIR sensors on a single focal plane array.
- Develop lightweight solid state night vision technologies.
- Develop low SWaP targeting technologies that enable employment of precision munitions in a GPS denied environment.



Expeditionary and Irregular Warfare

Force Protection Thrust Manager



Mr. Lee Mastroianni

- Force Protection Technology Investment Areas
 - Explosive Hazard Defeat
 - On the move, multi-modality detection and tracking
 - High probability detection with low false alarm rate of buried/obscured / moving objects
 - Fuse independent kill of buried/obscured objects
 - Counter Surveillance & Targeting
 - Pre-shot detection and classification
 - Air Defense/Counter Rockets, Artillery & Mortars
 - Real time detection/neutralization integrated system of systems
 - Personal Survivability
 - Enhanced personal protection while lightening the equipment load
 - Provide modular/tailorable protection





Force Protection (Cont'd)

•Research Opportunities:

- Orthogonal-mode signature stimulation
- System-level analysis tool to investigate system agnostic variables including crowd dynamics and flow, sensor placement, geometry, and generic sensor performance models.
- Smart Mine Counter Measure (SMCM) for defeat of multi-modal explosive hazard.
- Application of high powered lasers to USMC air defense mission profile requiring an in-depth analysis to understand system parameter trade-offs between laser power, beam quality, beam director design, beam combining methodologies, jitter, recycle rate, prime power and cooling.
- Optical Augmentation: Detection of optical systems via active means
- Determining appropriate trade-off matrices for protective equipment on area of coverage, survivability, weight and comfort so that armor system designs can be optimized.



Expeditionary and Irregular Warfare

- Human Performance, Training & Education (HPT&E) Technology Investment Areas

- Decision Making & Expertise Development

- Low-cost, fully immersive training systems that enhance training while reducing costs.
- Individualized training programs and tools using automated instructional technologies that are affordable, flexible and interoperable.
- Individual and small unit leader adaptability and decision-making training using current learning science to increase efficiency and future training.

- Warrior Resilience

- Ability to deliver individualized resilience-building approaches in response to immediate needs.
- Develop methods and training strategies for small unit and team leader focused resilience training.
- Understanding of the fundamental components of resilience: mental, physical and social performance in individuals.

HPT&E Thrust Manager



Dr. Peter Squire





HPT&E (Cont'd)

- **Research Opportunities:**

- Map out individual neuro-dynamic, physiological, and behavioral indicators of resilience.
- Identify the interplay between nutritional supplementation, physical conditioning, and operational performance, in the context of combat tasks.
- Model exposure and recovery processes of body and brain to combat stressors, recovery, reset, and pre-deployment work-ups.
- Develop, test and evaluate compelling virtual/immersive resilience building training strategies and technologies.
- Identify small team social indicators and leader characteristics associated with team resilience.



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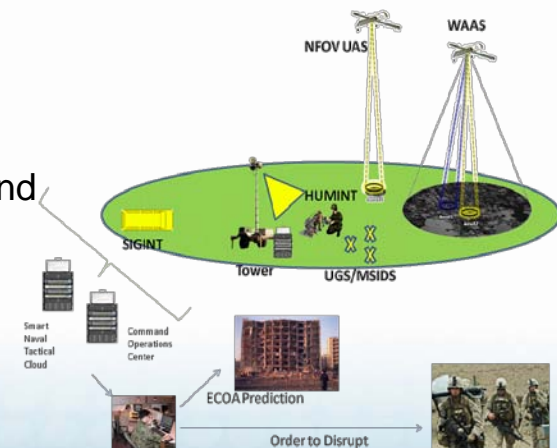
- **ISR Technology Investment Areas**

- **Persistent Intelligence, Surveillance, and Reconnaissance**
 - Develop long life (10 yrs.) smart unattended ground sensors for site protection.
 - Develop a PISR system with interchangeable sensors that functions as one.
 - Develop a multi-INT sensor suite for tactical unmanned airborne systems.
- **Knowledge Generation**
 - Automated network discovery using all source intelligence.
 - Predictive capability that uses both cultural and conventional intelligence data to infer intent and actions.
 - Ability to automate complex analytic workflows, including data and service discovery.
- **ISR to Command and Control**
 - PDA applications to translate conditions and entities of interests into data subscriptions.
 - Wiki based visualization of all relevant information to a situation.
 - Cloud enabled environment that anticipates, discovers and delivers needed information to a warfighter.

ISR Thrust Manager



Mr. Martin Kruger





ISR (Cont'd)

• Research Opportunities:

- Automate sensor planning based on commander's information requirements
- Enable wide area and collaborative tactical surveillance sensor suites
- Perform entity recognition from sparse data
- By increasing exploitation tasks per watt, enable sensor on-board processing to move from object detection to situational understanding
- Develop state of the art power efficient sensors and algorithms
- Automate entity and context recognition from unstructured data to enable meaning extraction
- Orchestrate workflows of advanced mission applications working against a cloud of data
- Automate advanced analytics across distributed cloud workflows to produce finished intelligence products
- Automate enemy course of action prediction
- Enable automated search against concepts such as mission information needs
- Enable the recognition and delivery of mission essential data without prior examples



Expeditionary and Irregular Warfare

Logistics Thrust Manager

• Logistics Technology Investment Areas

- Logistics Information Technology
 - Real-time tracking, delivery estimates, and condition/status information anywhere in the supply chain.
 - Fully autonomous logistics systems, capable of proactively ordering and delivering based on battlefield conditions.
- Package Handling, Shipping and Transport
 - Low-energy sealable plastics
 - Integrated low-power sensors to enable sensitive end effectors.
- Utilities
 - Improved GIS system algorithms for autonomous water site selection
 - Bio-inspired self regenerating anti-fouling coatings
- Logistics Operational Analysis
 - Complete mapping and flow analysis of the expeditionary supply chain for various operational scenarios



Mr. Cody Reese

Deputy



Capt Frank Furman

Lift Visibility - Rapid Booking & Delivery



Cost Effective Worldwide Delivery



Logistics (Cont'd)

• Research Opportunities:

- Cloud architectures & cooperating intelligent agents
- Low-cost/low-power tags capable of operating without infrastructure for shelf-life of supplies while transparently and securely feeding logistics information infrastructure
- Semantic web interfaces to diverse, mature, and sometimes unknown authoritative data sources
- Reduce weight, cost, and fragility of monitoring systems while maintaining tactically effective accuracy
- Autonomous packaging of non-standard items in dynamic environments
- Digital batteries with low self-discharge rates
- Hydraulic energy recovery systems
- Sulphur-tolerant JP-8 fuel cell technologies
- Self sufficient warfighter trade-space analysis
- Operational environment resource characterization
- Mapping traditional logistics supply models to the expeditionary environment



Expeditionary and Irregular Warfare

Maneuver Thrust Manager



Mr. Jeff Bradel

• Maneuver Technology Investment Areas

- Autonomy
 - Autonomously navigate on and off-road terrain at tactically appropriate speeds
 - Low-cost, day/night, and adverse weather perception capability
- Mobility
 - Fuel efficiency increases across the current and future USMC fleet
 - Improve vehicle off-road mobility and agility without sacrificing survivability of ground and amphibious vehicles
 - Develop on board exportable power capabilities that enable idle off operation and support future vehicle system payloads
- Survivability
 - Reduce vehicle armor weight and cost while maintaining or improving ballistic performance
 - Develop vehicle protection systems to defeat all RPG & ATGM threats & select KE threats with low probability of fratricide or false alarm
 - Research next generation all-aspect camouflage for ground vehicles in the visible & thermal spectrum with all weather and terrain performance
 - Develop automotive crash, vehicle roll-over & underbelly blast/IED technologies to reduce likelihood and severity of crew injury





Maneuver (Cont'd)

• Research Opportunities:

- Autonomy
 - Affordable sensor suites for enhanced perception with day/night and adverse weather capabilities
 - Intelligence enablers and architectures for adaptation to varied environments and missions
 - Warfighter-UGV collaboration and natural teaming interfaces
 - Systems engineering for robust, open source, low cost autonomy kit capabilities
- Mobility
 - Reducing fuel consumption technology of the legacy and future fleet (wheeled, track, hovering landing craft)
 - Increased vehicle trafficability (speed, ride quality, stability)
 - Maintain or improve vehicle performance while operating on military fuels
 - Increase onboard generator/exportable electric power while maintaining current weight, in modular form factor, to improve silent watch/mobility capability
- Survivability
 - Integrated advanced camouflage for ground systems
 - Enhanced, affordable lightweight armor systems
 - Crew Protection technologies to mitigate injuries from mine/IED attacks and vehicle rollover
 - Active & reactive protection systems to defeat RPGs/ATGMs



Other Program Officers You Should Meet

Name	Program	ONR Code	Room
Dr. Dan Prono	Sciences Addressing Asymmetric Explosive Threats (SAAET)	30	Arlington
Ms. Lisa Albuquerque	Naval Expeditionary Dog Program (NEDP)	30	Arlington
Mr. Clark Phillips, Mr. Gary Kollmorgen	Human, Social, Cultural, Behavioral Sciences (HSCB)	30	Arlington
Mr. John Garvin	Demonstration Manager	30	Arlington



Questions?

Visit us at:

<http://www.onr.navy.mil/home/Science-Technology/Departments/Code-30.aspx>